SELECTED TOPICS
In Aerospace Engineering

EDITOR

ERWIN SULAEMAN

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TABLE OF CONTENT

CHAPTER TWO

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

CHAPTER SIX

CHAPTER THIRTEEN

MINIMUM DENOMINATOR OF RATIONAL FUNCTION

CHAPTER FOURTEEN

TORSIONAL STIFFNESS MATRIX OF NON-PRISMATIC BEAM ELEMENTS

CHAPTER FIFTEEN

BENDING STIFFNESS MATRIX OF NON-PRISMATIC BEAM ELEMENTS

CHAPTER SIXTEEN

FORMULATION OF KERNEL FUNCTION FOR AERODYNAMIC LOADING ON AIR VEHICLE

CHAPTER SEVENTEEN

UNSTEADY AERODYNAMIC THEORY OF LIFTING SURFACE

CHAPTER EIGHTEEN

NUMERICAL EVALUATIONS OF HYPERGEOMETRIC CYLINDRICAL FUNCTIONS

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NUMERICAL EVALUATIONS OF HYPERGEOMETRIC CYLINDRICAL FUNCTIONS

18.1. Introduction

Evaluation of hyper-geometric transcendental functions occurring in the formulation of the kernel function of unsteady aerodynamic load is described in this chapter. The hypergeometric functions is known also as complete cylindrical functions in the forms of modified Bessel functions and Struve functions. Accurate and efficient evaluations of these functions are required in order to improve the robustness and accuracy of the aerodynamic load simulation

18.2. Kernel Integral Function

The calculation of the kernel function requires evaluations of several integral forms that may be classified into two types:

Type A $$B_n = \frac{I_n}{r^2} = \frac{1}{r^2}\int_{\frac{-X}{r}}^{\infty} \frac{e^{iku}}{(1+u^2)^{n+\frac{1}{2}}}\, du \qquad (18.1a)$$

where the lateral distance r is not involved in the algebraic part of the integrand

Type B $$B_n = \frac{1}{r^2}\int_{-x}^{X} \frac{e^{iku}}{(r^2+u^2)^{n+\frac{1}{2}}}\, du \qquad (18.1b)$$

where the lateral distance r is included in the integrand

To solve the integral problem above it is customary to divide the interval of the integration into two sub-intervals [-∞, 0] and [0,X] as follow

$$B_n = \frac{1}{r^2}\int_{-\infty}^{0} \frac{e^{iku}}{(r^2+u^2)^{n+\frac{1}{2}}}\, du + \frac{1}{r^2}\int_{0}^{x} \frac{e^{iku}}{(r^2+u^2)^{n+\frac{1}{2}}}\, du = B_n(0,x) + B_n(0,X) \qquad (18.2)$$